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ABSTRACT

This student module on precautions for explosive materials is one of 50 modules concerned with job safety and health. This module provides a brief introduction to the types of explosive materials, their classification, and safe procedures for transport, unloading, and storage. Following the introduction, 11 objectives (each keyed to a page in the text) the student is expected to accomplish are listed (e.g., Describe two general categories of explosives). Then each objective is taught in detail, sometimes accompanied by illustrations. Learning activities are included. A list of references and answers to learning activities complete the module. (CT)

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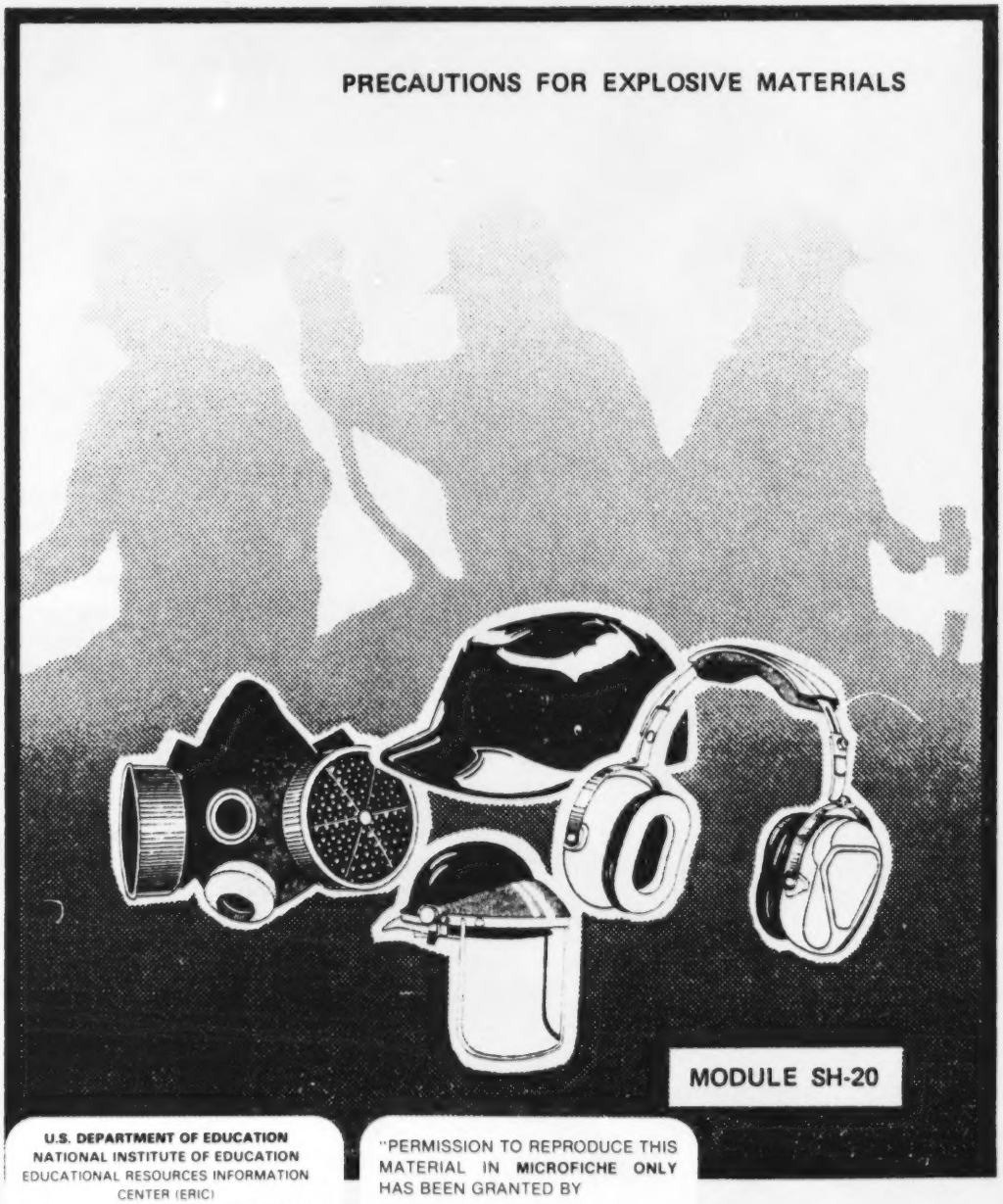
ED213854

SAFETY AND HEALTH

PRECAUTIONS FOR EXPLOSIVE MATERIALS



MODULE SH-20

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INTRODUCTION

An explosive is a chemical compound or mixture that is capable of suddenly undergoing a very rapid chemical change, during which large quantities of heat and gases are produced. The rapid chemical change, or explosion, is usually accompanied by a vigorous shock and loud noise.

Explosions that are intentionally set off to serve some purpose in industry, such as in mining, construction, or agriculture, are carefully planned. A safe explosive reaction usually involves a series of explosions that take place in a certain sequence. This series of events, known as the explosive train, may require the use of several different explosives or explosive devices, all of which must be handled with respect for their destructive potential. Only a trained, qualified person may actually use explosives and carry out the duties of blasting. However, many workers may encounter or aid in the transport of explosives, and so some general information about the different types of explosives and how to handle them is important to know.

This module provides a brief introduction to the types of explosive materials, their classification, and safe procedures for transport, unloading and storage.

OBJECTIVES

Upon completion of this module the student should be able to:

1. List six general guidelines concerning explosive materials. (Page 3)
2. Describe two general categories of explosives. (Page 4)
3. Describe six kinds of explosive products or devices. (Page 5)
4. Describe the Department of Transportation classes of explosives. (Page 9)
5. Identify the precautions necessary for safe unloading of explosives from a rail car. (Page 11)
6. List the safe procedures for transporting explosives by motor vehicle. (Page 13)

7. Describe the correct response to a fire in a motor vehicle transporting explosives. (Page 15)
8. Describe safe storage provisions for explosives. (Page 18)
9. Discuss the safety and health aspects of explosives. (Page 20)
10. Identify the main sources of information regarding explosives handling, including who to call if you find explosives or explosive devices. (Page 21)
11. Identify five common substances that can explode under certain conditions. (Page 22)

OBJECTIVE 1: List six general guidelines concerning explosive materials.

A competent, authorized person should always be in charge of explosives. The person in charge should know the federal, state, city, and other regional regulations and laws that pertain to the packing, marking, shipping, or handling explosives. For everyone other than authorized persons, the general rule should be simply "don't touch" without the proper guidance. Loading, unloading, storage, and transportation should be carried out under the direction of a qualified supervisor. Explosive materials should be kept away from unauthorized persons, especially from children, who have been known to mistake detonating devices for toys.

No source of ignition should be allowed within 100 feet of a blast area (except for lighting of the safety fuse during blasting) or within 50 feet of a magazine (explosive storage building) or vehicle containing explosive materials. Sources of ignition include matches, lit cigarettes, sparking metal tools, or any spark-producing or flame-producing devices.

Explosives should also be protected from excessive heat from flame producing devices, impact, or friction. Packages of explosives should be handled gently.

Explosive materials that are damaged or deteriorated should never be used. If you see such materials, or if the containers of explosive materials appear damaged, deteriorated, or leaking, report it to your supervisor at once. Since exposure to weather damages most explosives, every effort should be made to keep explosives dry and cool throughout transport and storage.

Horseplay around explosive materials must be strictly prohibited. Never shoot into explosive materials, magazines, or vehicles loaded with explosive materials.

Workers should not attempt to fight fires in explosive materials. All employees and bystanders should evacuate the areas of the fire (within 2000 feet).

ACTIVITY 1:*

1. Mark each statement True or False.

   ____ a. No source of ignition should be allowed within 100 feet of a magazine or vehicle containing explosive materials.

   ____ b. Explosives fires should not be fought.

   ____ c. Explosives should be protected from ignition, but they withstand heat well.

   ____ d. In case of explosives fires, people should be evacuated within a 200 foot area.

   ____ e. Some explosives are sensitive to impact.

   ____ f. Supervisors should be notified of damaged packages or containers, even if there is no leakage.

2. List five factors that could lead to deterioration of explosives and that should be avoided. Give examples of each factor.

   a. _____

   b. _____

   c. _____

   d. _____

   e. _____

OBJECTIVE 2: Describe two general categories of explosives.

Some explosives detonate (undergo explosive reaction or "go off") very rapidly and easily; these are classified as high explosives. Other explosives undergo chemical transformation hundreds of times more slowly and usually less readily; these are called low explosives. Low explosives are said to deflagrate (rapidly burn) rather than to detonate. While some high explosives detonate at a rate of four miles per second, some low explosives deflagrate at 900 feet per second. With either type of explosive, the release of heat

*Answers to Activities appear on page 24.

and gases is occurring very quickly; therefore, it should be clear that low explosive does not imply a low hazard.

High explosives can be subdivided into primary and secondary explosives. Primary explosives, such as dynamite, nitroglycerin, lead azide, and mercury fulminate, are extremely sensitive to heat, shock, and friction. Secondary explosives, such as tetryl, TNT, and cyclonite, sometimes require a booster (another explosive) to reach the point of explosion.

ACTIVITY 2:

Choose one answer from each pair.
Which of the following would be considered the most hazardous?

1. a. Primary explosives.
   b. Low explosives.
2. a. Deflagrating explosives.
   b. Detonating explosives.
3. a. High explosives.
   b. Low explosives.
4. a. Primary explosives.
   b. Secondary explosives.

OBJECTIVE 3: Describe six kinds of explosive products or devices.

Commercial explosives are considered to include, but are not limited to, high explosives, black blasting powder, blasting caps, electric blasting caps, non-electric delay blasting caps, and detonating cord. These materials are sensitive to impact, fire and friction in varying degrees and must be handled with appropriate care. Storage requirements are stringent and transportation regulations must be observed at all times.

High explosives decompose or explode almost instantaneously on being initiated or set off by a detonating action such as that of a detonator

(blasting cap, electric blasting cap), detonating cord or a special primer of some sort. Dynamite is the most common type of high explosive.

Black blasting powder is a deflagrating explosive that explodes much more slowly than dynamite. However, it is quite sensitive to spark, flame, and friction. Partly because of this, and partly because it is relatively expensive, black powder has been almost entirely replaced by safer and more economical high explosives and blasting agents.

Figure 1. Ordinary No. 6 blasting caps.

Blasting caps (ordinary blasting caps as shown in Figure 1) are short capsules closed at one end and containing a small quantity of one or more very sensitive, powerful high explosives. The capsules or shells are made of aluminum or copper. These caps, when ignited by means of a length of safety fuse, are used for initiating other explosives, such as dynamite.

Electric blasting caps (Figure 2) and delay electric blasting caps (Figure 3) are completely closed shells with two wires protruding from one end. The opposite end contains one or more small powerful charges of high explosive. Like the ordinary caps described above, these caps are also used for initiating other explosives, but are made to function by

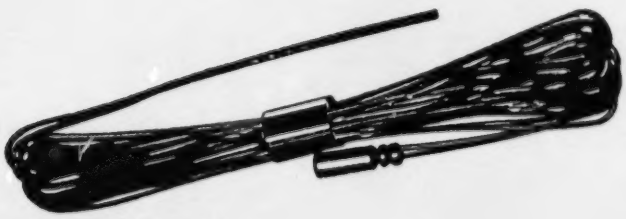

Figure 2. Electric blasting cap.

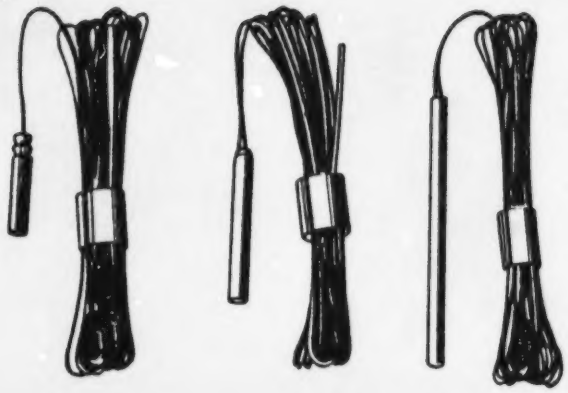

Figure 3. Delay electric blasting caps.

the application of electric current. Electric caps are less hazardous than the ordinary or fuse type, since the shell is completely closed.

All blasting caps, both ordinary or electric have the warning, "Blasting Cap — Explosive — Dangerous" printed on the shell. Blasting caps and electric blasting caps may explode prematurely when exposed to spark, heat, shock or friction; therefore, they should not be handled roughly, probed, connected to electric sources, or used as a toy by anyone. Every care should be taken to ensure that all types of caps (and other explosive products) do not get into the hands of children. Blasting caps should be employed for blasting only by or under the direction of fully experienced personnel.

Figure 4. Rolls of safety fuses.

Safety fuse (shown in Figure 4) is a flexible cord containing an internal burning medium by which fire or flame may travel at a continuous and uniform rate from the point of ignition to the point of use, which is usually a blasting cap. Safety fuse is made in two burning speeds, approximately 120 and 90 seconds per yard. The former is considered standard in the United States. However, these burning speeds are subject to manufacturing tolerances and, in addition, may be altered by various factors including storage, weather, atmospheric pressure, mishandling and conditions of use.

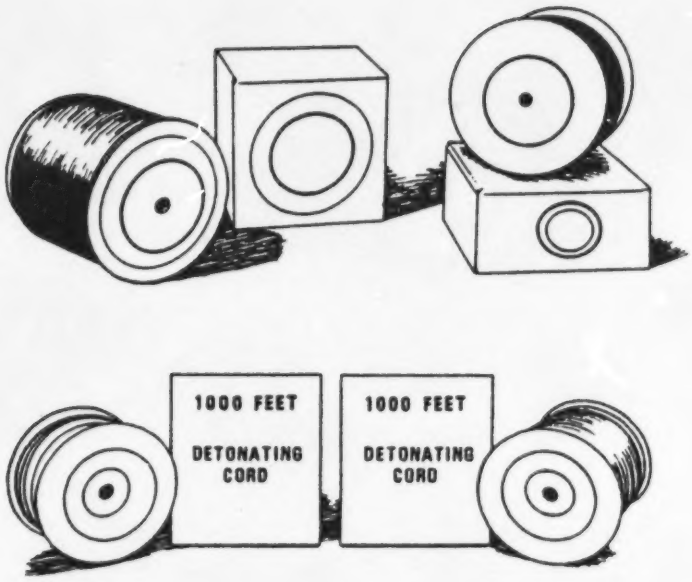

Figure 5. Detonating cord packed on spools containing 500 and 1000 feet.

Detonating cord (Figure 5) is a flexible cord containing a center core of high explosives used to detonate other explosives with which it comes in contact. Different types of detonating cord have different size cores and various combinations of coverings, which may include textiles, waterproofing compounds, and plastic, designed to protect the core from damage in handling and use, and from water penetration. The explosive in the core is initiated with a detonator (blasting cap or electric blasting cap) or other suitable initiator or booster and travels along the core at a rate of approximately 21,000 feet per second.

In addition to the commercial explosives described above, some other materials known as blasting agents are used extensively for commercial blasting, although they are not classified as explosives. Blasting agents are shipped under the designation "nitro-carbo-nitrate," often shortened to NCN. Ammonium nitrate and blasting agents (NCN's) are classified by the Department of Transportation (DOT) as "oxidizers" (materials that support burning) and are subject to the DOT Hazardous Materials regulations. Placarding (labeling) as "oxidizers" is required.

Water-gel (slurry) explosives, a recent development, have become widely accepted in recent years. Their safety characteristics are practically the same as those of the blasting agents. Many of them contain a high explosive sensitizer, however, and must be treated as a commercial explosive.

ACTIVITY 3:

Match the type of explosive listed on the left with its description on the right.

_____	1. Safety fuse.	a.	Not classified as explosives.
_____	2. Blasting caps.	b.	Used for initiating other explosives.
_____	3. Black powder.	c.	Flexible cord with a center of high explosives.
_____	4. Electric blasting caps.	d.	Function by application of current.
_____	5. Blasting agents.	e.	A cord which conveys flame to a blasting cap.
_____	6. Detonating cord.	f.	Very sensitive to spark, flame, and friction.

OBJECTIVE 4: Describe the Department of Transportation classes of explosives.

Explosives are among the hazardous materials identified by the Department of Transportation as capable of posing an unreasonable risk to health, safety, and property when transported in commerce. There are three main classifications of explosive materials: Class A, Class B, and Class C. The appropriate labels for each class are shown in Figure 6.

Figure 6. Placards for explosive materials.

CLASS A

Class A explosives are those that present a maximum hazard because of the ease with which they may be made to detonate or deflagrate. Class A explosives include both high and low explosives. Some examples of Class A explosives follow:

- Black powder.
- Dynamite.
- Trinitrotoluene (TNT).
- Trinitromethylene triamine (RDX).
- Penaerythritol tetranitrate (PETN).
- Picric acid.

Class A explosives can also include such items as rocket and cannon ammunition, hand grenades, naval torpedoes, land and sea mines, bombs, and explosive projectiles.

These Class A explosives are sometimes subdivided into nine types according to the relative ease of detonation, chemical composition, and physical state. These various types will not be discussed. It is sufficient to know that Class A explosives present the maximum hazard. Extreme caution and all applicable laws and regulations must be observed when they are handled, transported and used. Persons encountering Class A explosives should be aware that careless handling could result in detonation. Careless handling includes exposure to heat, ignition sources, friction, impact, and electrical impulses.

CLASS B

Class B explosives are those that are easy to ignite and that burn rapidly. They represent a flammable hazard rather than a detonation hazard. Examples include materials such as photoflash powders, jet-assisted takeoff (JATO) units, special effects fireworks, and most rocket propellants.

Although the hazard rising from Class B explosives may not be as great as from Class A, due precautions must be observed in their use.

CLASS C

Class C explosives are generally manufactured articles that may contain some Class A and/or Class B explosives, but only in very limited amounts. Included in this class are small arms ammunition, explosive rivets, fuses, igniters, squibs, ordinary fireworks, flares, and signals.

Some explosives are so sensitive to shock and heat that they cannot be transported by rail, highway, air, or water. These explosives are classified by DOT as "Forbidden." Some forbidden explosives are likely to detonate as a result of only a slight jar. If these materials are diluted, stabilized, or incorporated in devices, the "forbidden" classification may not apply.

ACTIVITY 4:

1. Which DOT class of explosives represents the greatest hazard?

   _____

2. Exposure of Class A explosives to heat, ignition sources, friction, impact, and electrical impulses could result in _____.

OBJECTIVE 5: Identify the precautions necessary for safe unloading of explosives from a rail car.

The consumer is responsible for the safe handling of explosives from the moment they are delivered. The transfer of explosive materials may occur from the railroad car which has been placed on the side track, from the supplier's truck on the consumer's premises or at the manufacturer's or dealer's magazine.

A number of precautions should be observed when unloading railroad cars of explosives. They should be unloaded promptly, as required by the Department of Transportation (DOT) regulations and in accordance with instructions on cards tacked on the inside of cars. When cars are opened, the seals should

be retained and a record taken of seal numbers. Railroad cars should not be left unattended between trips unless the car is locked.

Every precaution should be taken to prevent fire from reaching explosives while they are being unloaded. There should be no dry grass or debris within 25 feet of the car and, of course, there should be no smoking or carrying of matches by personnel.

Any runways, chutes or conveyors used for unloading should have no exposed sparking metal parts.

Packages of explosives should not be handled roughly. Throwing dropping, or slamming of packaged explosives should be carefully avoided.

Any damaged or leaking explosives packages should be reported to the supervisor, who should then segregate them, place them in supplementary tight containers, as necessary, and set them aside in a magazine after which a full report should be made to the manufacturer. All loose explosives and debris should be swept up and burned in the recommended manner. Only authorized personnel should dictate disposal procedures for damaged or empty explosive containers.

After unloading is completed, all placards should be removed from the car and the railroad notified.

ACTIVITY 5:

Fill in the blanks:

1. Rail cars of explosives should not be left _____ unless the car is locked.
2. There should be no _____ or _____ within 25 feet of a rail car of explosives.
3. Any runways, chutes, or conveyors for unloading rail cars of explosives should have no exposed _____ _____ _____.

OBJECTIVE 6: List the safe procedures for transporting explosives by motor vehicle.

When transporting explosives by motor vehicle, it is very important that the vehicle be in good condition, properly equipped and marked, and that all legal requirements be met. This applies equally to supplier's equipment in making delivery as well as the consumer's truck, whether transporting explosives on the public highway or on private property.

A motor vehicle used for transporting explosives is required to have adequate capacity for the job and to be in good condition. If a fully enclosed truck body is not employed, then an open body should have enough sideboard height to prevent packages of explosives from falling off and should have a fireproof tarpaulin to protect cargo from weather and fire. In all vehicles, electrical wiring must be secured and protected from contact with explosives. The truck floor should be tight, and exposed sparking metal that is likely to contact the cargo should be covered with wood or other non-sparking material.

Vehicles carrying explosives in interstate commerce must be marked or placarded in accordance with current Department of Transportation (DOT) regulations. Vehicles not subject to DOT placard requirements must be marked or placarded as required by the applicable local and state regulations. In the absence of such local or state regulations, DOT standards should be used.

Each motor vehicle used for transporting explosive materials shall be equipped with a minimum of two fire extinguishers. Only extinguishers listed or approved by a nationally recognized fire equipment testing laboratory shall be deemed suitable for use on vehicles. They shall be provided with a device permitting visual determination of charged condition. Extinguishers shall be located where they will be convenient and ready for immediate use. Extinguishers shall be examined and recharged periodically in accordance with manufacturer's recommendations. Where trucks are operated in sub-zero temperatures, dry powder extinguishers should be pressurized with nitrogen gas in lieu of carbon dioxide.

Vehicles should be in condition to pass the following inspection at all times:

- Fire extinguishers filled and in good working order.
- All electric wiring completely protected and securely fastened to prevent short-circuiting. Worn insulation should be repaired before any explosives are loaded on a motor vehicle.
- Chassis, engine, pan and bottom of body should be clean and free of surplus oil and grease.
- Fuel tank and feed line should have no leaks.
- Brakes, lights, horn, windshield wipers and steering apparatus should be functioning properly.
- Tires should be properly inflated and free of defects. All tires should be checked each time the truck is at rest or refueling and/or at intervals of 50 miles or within two hours' driving time. Running on flat tires will heat them up rapidly and they may catch fire. A flat or soft tire on a pair of duals should be replaced as promptly as possible. If a spare is not available and the truck must proceed, remove the flat or soft tire and drive at reduced speed to the nearest point where replacement or repair can be made.

The driver of the vehicle should be careful, capable, reliable, able to read and write English and not addicted to the use or under the influence of alcohol or drugs. The driver must not smoke, or carry matches or other flame-producing device, firearm, or ammunition while transporting explosives. The laws and regulations governing the transportation of explosives along the routes traveled should be known and followed by the driver. The driver should also be instructed that a truck must not be left unattended with explosives on board.

No sparking metal tools, carbides, oils, matches, firearms, electric storage batteries, acids, corrosive compounds or flammable substances should be carried in the body of a vehicle transporting explosives.

Detonators may be transported with other explosives in the same vehicle only in accordance with Title 49 of the Federal regulations. In intrastate commerce, except where prohibited by state or local laws and regulations, electric blasting caps and non-electric delay devices may be transported in the vehicle together with other explosives provided that these products are packed in Department of Transportation specification outside containers. In questionable situations the applicable state and local laws and regulations should be consulted.

The driver must drive at a safe speed and have his vehicle under control at all times regardless of traffic, road conditions, and weather and should avoid cities and congested areas whenever possible. He must come to a full stop before crossing a railroad track or entering a main intersection and must not permit unauthorized riders.

Refueling en route should be avoided whenever possible and should be done only with the motor stopped and brakes set.

Motor vehicles containing explosives should never be taken into a garage or shop for repairs, or stored at any time in a public garage or similar building, or where people assemble.

Explosives should be unloaded only in the care of someone authorized to receive them. They should be stored in an approved magazine. Packages of explosives should never be piled closely behind a motor vehicle exhaust pipe.

ACTIVITY 6:

Name six safety criteria for vehicles used to transport explosive materials.

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____

OBJECTIVE 7: Describe the correct response to a fire in a motor vehicle transporting explosives.

Fire in a motor vehicle transporting explosives constitutes a very serious hazard since an explosion is quite likely to result. In the event a fire should develop, the following steps should be taken immediately:

1. Pull off the road and stop. (Endeavor to avoid stopping near any school or building where there may be a concentration of people.)
2. Stop traffic in both directions and warn drivers and passengers and occupants of buildings to keep at least 2,000 feet away. (Enlist the help of anyone available for this.)
3. Local police or firemen offering assistance should be told the cargo is explosives.
4. If the vehicle hauling the explosives is of the tractor-trailer type, the tractor should be disconnected from the trailer and driven to a distance of at least 200 feet away.
5. If the fire involves only the engine, cab, chassis, or tires, an effort should be made to put it out with fire extinguishers, sand or dirt, or water. In the event of a tire fire, do not use all of the contents of the fire extinguishers as there is always the danger of a flashback fire after the initial fire has apparently been extinguished. As soon as possible remove the wheel involved.
6. Since tire fires are especially hazardous, the Institute of Makers of Explosives has made available a leaflet, "DANGER! BEWARE OF TIRE FIRES!" (Included are some precautions you can take to prevent tire fires and what to do if you have a tire fire.)
7. In the event the fire involves or spreads to the body of the vehicle or the cargo, STOP FIGHTING THE FIRE and get away from it — at least 2,000 feet distant. The Institute of Makers of Explosives has made available a Truck Emergency Procedure card giving instructions on what to do in case of a truck fire (see Figure 7).

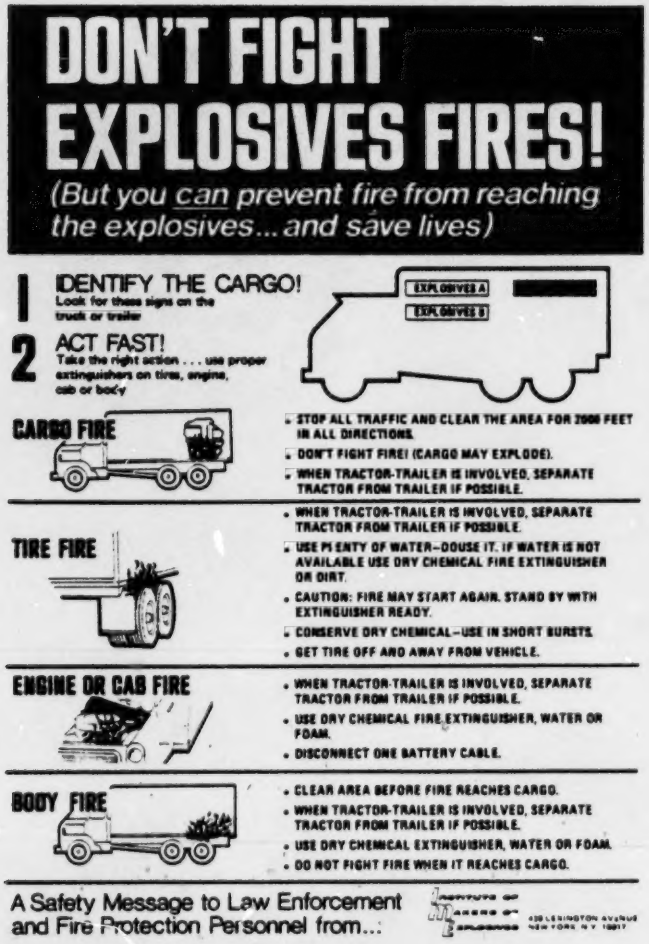
DON'T FIGHT EXPLOSIVES FIRES!
(But you can prevent fire from reaching the explosives... and save lives)
1 IDENTIFY THE CARGO!
Look for these signs on the truck or trailer
2 ACT FAST!
Take the right action . . . use proper extinguishers on tires, engine, cab or body
EXPLOSIVES A
EXPLOSIVES B
CARGO FIRE
• STOP ALL TRAFFIC AND CLEAR THE AREA FOR 2000 FEET IN ALL DIRECTIONS.
• DON'T FIGHT FIRE! (CARGO MAY EXPLODE).
• WHEN TRACTOR-TRAILER IS INVOLVED, SEPARATE TRACTOR FROM TRAILER IF POSSIBLE.
TIRE FIRE
• WHEN TRACTOR-TRAILER IS INVOLVED, SEPARATE TRACTOR FROM TRAILER IF POSSIBLE.
• USE PLENTY OF WATER—DOUSE IT. IF WATER IS NOT AVAILABLE USE DRY CHEMICAL FIRE EXTINGUISHER OR DIRT.
• CAUTION: FIRE MAY START AGAIN. STAND BY WITH EXTINGUISHER READY.
• CONSERVE DRY CHEMICAL—USE IN SHORT BURSTS.
• GET TIRE OFF AND AWAY FROM VEHICLE.
ENGINE OR CAB FIRE
• WHEN TRACTOR-TRAILER IS INVOLVED, SEPARATE TRACTOR FROM TRAILER IF POSSIBLE.
• USE DRY CHEMICAL FIRE EXTINGUISHER, WATER OR FOAM.
• DISCONNECT ONE BATTERY CABLE.
BODY FIRE
• CLEAR AREA BEFORE FIRE REACHES CARGO.
• WHEN TRACTOR-TRAILER IS INVOLVED, SEPARATE TRACTOR FROM TRAILER IF POSSIBLE.
• USE DRY CHEMICAL EXTINGUISHER, WATER OR FOAM.
• DO NOT FIGHT FIRE WHEN IT REACHES CARGO.
A Safety Message to Law Enforcement and Fire Protection Personnel from...

Figure 7. Truck Emergency Procedure card from the Institute of Makers of Explosives.

ACTIVITY 7:

Mark each statement true or false.

_____ 1. A bystander can provide a valuable service in attempting to fight an explosives fire.

_____ 2. The area surrounding a fire in a motor vehicle carrying explosives should be evacuated to a distance of 2,000 feet away.

OBJECTIVE 8: Describe safe storage provisions for explosives.

All explosives, blasting agents, blasting caps, electric blasting caps, and detonating cord should be stored in magazines, properly designed and located to comply with all applicable federal, state and local laws, rules and regulations. Magazines must be kept securely locked at all times except for inspection, inventory, or the movement of blasting material in or out. The purpose of approved storage is primarily one of safety by preventing unauthorized access to dangerous products, by preventing deterioration of blasting materials with attendant hazards and by minimizing the chance of injury to employees and the public and damage to property in the event of an accidental explosion.

There are five types of storage magazines. These types, together with the classes of explosive materials which shall be stored therein, are as follows:

- Type 1 storage magazines. Permanent facilities for the storage of high explosives. Other classes may also be stored therein.
- Type 2 storage magazines. Portable indoor and outdoor facilities for the storage of high explosives. Other classes may also be stored therein.
- Type 3 storage magazines. Portable outdoor facilities for the temporary storage of high explosives while attended. Other classes may also be stored therein.
- Type 4 storage magazines. Facilities for the storage of low explosives such as black powder. Blasting agents, or electric blasting caps having leg wires at least four feet long (provided they are in configuration as supplied by the manufacturer) may also be stored therein.
- Type 5 storage magazines. Facilities for the storage of blasting agents.

The storage of blasting caps, electric blasting caps, detonating primers and primed cartridges with other explosives is not allowed by federal regulations. Other types of Class A explosives may be stored with Class B and C explosives, but the classes of explosives must be kept segregated within the magazine.

Detonating cord shall be stored in a Type 1, 2 or 3 magazine and may be stored in the same magazine with other explosive materials under certain circumstances.

Magazines must be located and constructed in accordance with federal, state and local regulations, or as recommended by the Institute of Makers of Explosives in its publications. The American Table of Distances, revised and approved by the Institute in 1971, has been accepted by practically all governing bodies for the control of magazine locations. This table specifies the respective distances that magazines of various sizes should be placed from each other and from the nearest inhabited building, passenger railway, public highway, or navigable stream for quantities of explosives ranging from two pounds to 300,000 pounds. Magazines should be constructed so that they are clean, dry, well ventilated, reasonably cool, properly located, substantially constructed, securely locked, weather resistant, fire resistant and theft resistant.

Magazine locations and access roads should be posted with signs reading "Explosives — Keep Off" — so placed that a bullet passing through any sign will not strike the magazine.

ACTIVITY 8:

Name eight criteria of a properly constructed storage magazine.

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____

OBJECTIVE 9: Discuss the safety and health aspects of explosives.

Besides the hazard of potential explosion, several health hazards are associated with some explosives. Explosives can be toxic and should never be ingested through food contamination, nor should prolonged skin exposure or eye contact be allowed. Inhalation of dust or vapors from explosive materials should be avoided. To prevent such hazardous exposures, packaging from explosive materials should not be recycled for explosives packaging or other uses. All contact with explosive materials should be avoided except under the direction of a competent, authorized person.

Blasting may produce excessive noise. If this is the case, workers in the area of noise exposure should wear hearing protection in accordance with Federal, State, or local laws and regulations.

After a blast, toxic fumes may be present from blasts or burning explosive materials. Applicable Federal, State and local laws regarding safe fume levels should be complied with before workers return to work in the blast area.

ACTIVITY 9:

Name two potential health hazards associated with explosives.

1. _____
2. _____

OBJECTIVE 10: Identify the main sources of information regarding explosives handling, including who to call if you find explosives or explosive devices.

As stated in Objective 5, Department of Transportation (DOT) regulations govern the transportation of explosives. Copies of the Department of Transportation Regulations can be obtained by writing to the Association of American Railroads, Bureau of Explosives, Washington, D.C. 20036, or direct to the Department of Transportation, Hazardous Materials Regulations Board, in Washington, D.C. 20590.

The Occupational Safety and Health Act includes regulations which apply to the manufacture and use of explosives. These may be obtained by writing to the Department of Labor, Washington, D.C.

The Mining Enforcement and Safety Administration under the Department of Interior has regulatory authority in the functions of mine health and safety assessment and compliance, education, and training. This authority includes jurisdiction over blasting procedures, devices, and other aspects of explosives safety.

Information about state laws regarding transportation, storage, and use of explosives may be obtained through the Bureau of Alcohol, Tobacco and Firearms, Washington, D.C. The Bureau has prepared a compilation of these various laws.

A group of companies that manufacture explosives have formed the Institute of Makers of Explosives, constituted of field persons of the different companies. This group publishes excellent safety information about explosives, furnished to consumers by request at a nominal cost. The Institute is able to advise explosives users about problems or questions not covered in the safety library material. When the manufacturer of a given explosive is unknown or unavailable to offer assistance, the Institute will supply aid in destroying explosives to law enforcement agencies, users, and government agencies.

Manufacturers are a good source of advice and information, and also make available Material Safety Data Sheets on specific products.

If you find explosives or explosive devices, report them to the nearest police, sheriff, fire department, or military unit. If you are on the job,

report to your supervisor. Do not touch the explosive materials, and keep others out of the area.

ACTIVITY 10:

Answer the questions.

1. What organization or agency would be called for information concerning destroying explosives?

   _____

2. Concerning regulation of transportation of explosives?

   _____

OBJECTIVE 11: Identify five common substances that can explode under certain conditions.

Many of the explosive materials discussed earlier in this module are likely to be encountered primarily in an industrial setting or under controlled conditions of transport. Usually these materials are properly labeled and placarded, so that people are adequately warned of their hazards.

A number of more common materials, while not classifiable as explosives under the DOT system of classification, also have a high hazard potential. Under certain conditions, many materials used in homes, farms, and offices can and do explode.

Agricultural dusts, finely suspended in certain concentrations, can explode with all the force and destruction of dynamite. Flour, cinnamon, starch, and many other agricultural dusts must be carefully controlled during processing and storage to prevent disastrous explosions.

Finely divided metals (like flake aluminum) should be stored in closed containers. Moisture and dampness enhance spontaneous combustion and, should the metals become wet (through improper construction or maintenance of storage drums), fire and explosion may result. Use of equipment with internal combustion engines should be restricted in areas where combustible or explosive materials are stored or processed or the equipment should have a flame or spark-arresting device.

Battery-charging operations produce hydrogen gas, and an explosive atmosphere may result if adequate ventilation is not provided. "NO SMOKING" signs must be posted in such areas.

Methane gas may be found in tank, pit, sump, or drain cleaning operations, or wherever decaying organic material has accumulated. Colorless, odorless, and tasteless, methane is highly flammable and is also an explosive hazard. Ignition sources should be kept away from decomposing organic matter, and confined areas where such matter is present should be tested before entry by workers.

Ammonium nitrate, used in fertilizer, can explode under certain circumstances and should be stored in well-ventilated areas, away from oils or hydrocarbons.

These are only a few of the materials in everyday use that have explosive potential. The best insurance against a disastrous encounter with any harmful substances is to read labels carefully, follow directions, and ask your supervisor for help and information when you need it.

ACTIVITY 11:

List five substances (or types of substances) that can explode under certain circumstances.

1. _____
2. _____
3. _____
4. _____
5. _____

REFERENCES

Institute of Makers of Explosives. Safety in the Transportation Storage, Handling, and Use of Explosives. New York, NY: Safety Library, Publication No. 17, May 1980.

Institute of Makers of Explosives. Do's and Don'ts Instructions and Warnings. New York, NY: Safety Library, Publication No. 4, July 1978.

_____. Glossary of Industry Terms. New York, NY: Safety Library.

Meyer, Eugene. Chemistry of Hazardous Materials. Englewood Cliffs, NJ: Prentice-Hall, Inc., 1977.

U.S. Department of Labor. Handling Hazardous Materials, OSHA Publication No. 2237, Washington, 1975.

ANSWERS TO ACTIVITIES

ACTIVITY 1

1. a. False.
   b. True.
   c. False.
   d. False.
   e. True.
   f. True.
2. a. Heat.
   b. Ignition sources.
   c. Impact.
   d. Friction.
   e. Electrical impulses.

ACTIVITY 2

1. a.
2. b.
3. a.
4. a.

ACTIVITY 3

1. e.
2. b.
3. f.
4. d.
5. a.

6. c.

ACTIVITY 4

1. Class A.
2. Detonation.

ACTIVITY 5

1. Unattended.
2. Grass or debris.
3. Sparking metal parts.

ACTIVITY 6

Fire extinguishers filled and in good working order.

All electric wiring completely protected and securely fastened to prevent short-circuiting. Worn insulation should be repaired before any explosives are loaded on a motor vehicle.

Chassis, engine, pan and bottom of body should be clean and free of surplus oil and grease.

Fuel tank and feed line should have no leaks.

Brakes, lights, horn, windshield wipers and steering apparatus should be functioning properly.

Tires should be properly inflated and free of defects. All tires should be checked each time the truck is at rest or refueling and/or at intervals of 50 miles or within two hours' driving time. Running on flat tires will heat them up rapidly and they may catch fire. A flat or soft tire on a pair of duals should be replaced as promptly as possible. If a spare is not available and the truck must proceed, remove the flat or soft tire and drive at reduced speed to the nearest point where replacement or repair can be made.

ACTIVITY 7

1. False.
2. True.

ACTIVITY 8

Any eight of the following:

1. Clean.
2. Dry.
3. Well-ventilated.
4. Cool.
5. Properly located.

6. Substantially constructed.
7. Securely locked.
8. Weather-resistant.
9. Fire-resistant.
10. Theft-resistant.

ACTIVITY 9

1. Toxicity.
2. Noise.

ACTIVITY 10

1. IME.
2. DOT.

ACTIVITY 11

1. Agricultural dusts.
2. Metal dusts.
3. Hydrogen from battery-charging operations.
4. Methane gas.
5. Ammonium nitrate.